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AUTHOR Fuller, Renee
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ABSTRACT

This paper describes the Ball-Stick-Bird reading system, which shows students how all the letters of the alphabet can be built with three basic forms: a circle (ball), a line (stick), and an angle (bird). The method also uses modified phonics and developmental linguistics, aids story reading by using capital letters in the beginning, and enhances story comprehension by laying out the story in idea units. Successful use of the system with individuals with various disabilities is documented. Evidence that low-intelligence subjects were able to learn to read advanced material with comprehension and to write stories led to development of a new paradigm of cognitive/neurological organization. This paradigm views story comprehension as so fundamental and overrepresented in the human brain that even a severely damaged brain can almost always call on this capacity. The fundamental unit of cognitive organization is the idea unit, which is actually a miniature story. The Ball-Stick-Bird method mimics the developmental process, by using idea units to build bigger stories. The idea unit, termed the "story engram," functions as a cognitive organizer and therefore structures conscious reality. As students learned to use the story engram to build bigger stories, they matured far beyond expectations because, having learned to impose a structure on the world around them, they saw themselves as having acquired a structure, an identity. (JDD)

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Ball-Stick-Bird: Teaching with the Story Engram

Renee Fuller

Abstract. For almost two decades, the Ball-Stick-Bird reading system, an innovative approach to learning, has produced results which have raised profound questions about the nature of intelligence and IQ. What follows is a description of the system, a summary of the findings, and finally an attempt to understand the implications of these surprising findings within a neurological-behavioral-evolutionary framework. This new theory of cognitive organization, the story-as-the-engram theory, offers (1) an explanation for our species' sudden and meteoric intellectual development, and (2) the possibilities for even greater achievement.

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The Ball-Stick-Bird reading system derives its name from the way it highlights alphabet configurations. The student is shown how all the letters of the alphabet can be built with three basic forms: a circle, a line and an angle. These three shapes, which are playfully called a ball, a stick and a bird, are so basic to the human nervous system that a newborn recognizes them. Even an octopus can be trained to respond to them.

By building the letters with the three forms while giving their most usual sounds, four sense modalities are

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tapped instead of the usual two. Further, the three basic forms highlight those parts of a letter that differentiate it from other letters.

Story reading, however, does not wait for alphabet mastery. The strategy is to get to genuine reading as rapidly as possible. Beginning reading is taught with capitals which have the additional advantage of avoiding letter reversals since in B-S-B letter building, the big stick is always first (to the left). Also letters are known by their most usual sound, rather than by their alphabet names, again reducing the initial memory load.

Already with the presentation of the second letter word building begins. With the presentation of the fourth letter the first science fiction story starts. To achieve such rapid immersion into story reading, the order of alphabet presentation is altered. The simplest and high frequency letters are presented first. Letters that make the same sound appear contiguously, while those with a similar look or sound are presented far apart to avoid interference.

Modified phonics are used which do not require fine sound discriminations. Since in English the correspondence between between letter and sound tends to be sloppy, the inaccuracies of a student's speech are harnessed to the advantage of the reading process. Approximate soundings come surprisingly easily. But Ball-Stick-Bird takes the process a step further by teaching "code approximation". The student is told that he is a detective, and that the letters are the clues that indicate what the word might be. But like all clues, they have to make sense in the context of the story. Because with code approximation reading is dependent on comprehension, word calling is all but impossible.

To help reading comprehension, developmental linguistics is utilized for the beginning stories which are built primarily with nouns and verbs; gradually adjectives and adverbs are introduced. Only in later books are the more difficult parts of speech (the articles, connectives, and prepositions) used.

Story comprehension is further enhanced and facilitated in the beginning books by the layout. Each idea unit, comprising mainly of a noun and its action verb, has its own line. These idea units, representing sub-stories, are used to construct the bigger story, line by line. In this way the layout highlights story building, producing a graphic image of how ideas are put together, how a paragraph is developed. Comprehension can now become not only the purpose of reading, but via developmental linguistics, layout in idea units, and code approximation, is used to help the student learn to read (Fuller, 1974, 1975, 1977).

The reading system, which had been intended for older non-readers with normal or superior IQ, was successful far beyond this group. Normal four-year-olds became advanced readers with astonishing ease, and there was not a single case of dyslexia (Fuller, 1987). The severely retarded did as well. In a detailed study, a group of 26 institutionalized retardates with IQ's as low as 28, who had previously been exposed to extensive educational intervention, and in spite of this had not mastered most of the alphabet, easily learned to read; 24 of them with comprehension (Fuller, 1974, 1977). Adult illiterates became proficient readers in weeks instead of years.(Fuller, 1988). Non-English speakers, the ESL group, found the books an open sesame into English.

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But much more than reading had been learned. There were profound cognitive changes which had little relation to IQ or to mental age (Fuller, 1988; Fuller, Shuman, Schmell, Lutkus & Noyes, 1975). Unexpected as these results with the very young and the severely retarded were, even more unexpected was that they had been achieved with a technology requiring extensive intellectual feedback and contextual understandings. The use of code approximation, developmental linguistics, and layout in idea units, demand a knowledge of language that the very young, the severely retarded, the ESL group, are presumed to lack.

What had the reading system tapped that was not being measured by the IQ or language tests? What aspect of neural organization, of cognition, had been reached by the teaching system? In spite of the extensive and detailed testing and background data we had, it took my years to unravel this mystery (Fuller, 1979, 1982, 1985). What follows describes this unraveling process and some of its implications.

The Discovery of the Memory Engram With Which We Think

For the past 50 years psychology has been looking for the basic unit of memory called the engram. This search for the fundamental unit of how we think and remember had always struck me as a quest for a mythical construct which had little likelihood of becoming a reality. The history of psychology is replete with mythical constructs that after a generation of popularity peacefully disappear. It was difficult to imagine a neurological/behavioral unit like the engram that would explain how we see ourselves and our world. Much as I admired the work of Karl Lashley (1963), his inability to find the engram after years of

research seemed to prove the point: the engram is a mythical construct that would, before long, quietly glide into oblivion. Which is why when we stumbled on what now looks very much like the engram, I didn't recognize what we had found.

There is safety in the old paradigm

Even after we had presented our results at an American Psychological Association symposium devoted solely to Ball-Stick-Bird, what now seems obvious was not apparent. In detail we described what had happened to our severely retarded subjects; the effects on vocabulary, passage reading and understanding, on word list reading, on following written directions. But the why question, why our low IQ subjects had been able to learn to read advanced material with comprehension, and write such sophisticated letters and even stories - that question was not really answered. My partial explanation was superficial and therefore safely correct. To wit, apparently some abstract cognitive operations are simpler for the human brain than the memorization of bits of unstructured material. Further, these bits of information are similar to the items sampled by IQ tests; which would explain why the success of our population was not correlated with their IQ scores. The question of what exactly in cognitive/neurological organization the Ball-Stick-Bird system had tapped remained unanswered.

Our audience repeatedly suggested the motivational aspect as the answer. Perhaps because the stories and the drawings were so entertaining...and yet, how could that explain success so far down the IQ scale? Gauging from the letters and notes our students had written to me, the author of the books they enjoyed, motivation was an important

factor; but did the system tap into some specific aspect of cognitive organization?

The paradigm begins to shift

The first realization of some specific aspect being involved came with Ned who had been giving us puzzling results. He had learned the alphabet and word building quite rapidly. But then, more than a year later he still could not combine the words into sentences. All the other students, except one, had been reading sentences long before they had mastered all the alphabet.

Joyce, one of our "reading" psychologists pointed out that "Ned's got survival reading -- that's something. It's more than ten years of schooling did for him."

I had to agree. But why, when we had succeeded in teaching advanced reading to IQ's in the 30's were we failing with someone who had an IQ in the 60's? It wasn't logical. Although there was Gordy, the other exception who had not mastered the reading of sentences even though he too had no trouble learning the alphabet and word building when taught with the reduced memory-load techniques of B-S-B. Did Ned and Gordy have a common denominator?

It's an old adage in science that sometimes our failures tell us more than our successes. Would the understanding of Ned and Gordy's failure explain why the others, not only learned to read advanced material with comprehension, but why they turned into thinking human beings. At this stage, however, I understood neither the reason for our failures nor the reason for our successes.

The initial search for the common denominator between Ned and Gordy produced nothing. Both had come from

destitute families with a history of trouble with the law. But that was true of most of our students. Both Ned and Gordy had set fire to their schools. That too was not unusual. Since we had chosen subjects who despite years of the best remedial schooling of every type had not mastered even the alphabet, our students represented the failures among the failures at the institution for the retarded. With their extensive neurological and sociological damage they were the dregs of society, physically, emotionally and socially. However, in spite of so much of nature and nurture being against them, we had succeeded in teaching them advanced reading, and to our amazement had seen them turn into responsive human beings. But not Ned and Gordy. Why?

Perhaps their IQ tests would show something. But even the most careful scrutiny of all the subtests showed nothing unusual. We tried to make the lessons more exciting by actually reading some of the stories to Ned, hoping that in this way he would get the point of reading, that he would begin to follow the story. He didn't.

I watched the teaching through the one-way mirror, trying to determine what was wrong. However, all I saw was Judy, one of our psychologists, doing an exciting teaching job. What was it that I wasn't seeing? Finally, taking the course of last resort, I broke into the teaching session. Judy obviously agreed with my decision, for on opening the door her

"It's about time" greeted me.

But my teaching was just as frustrating as hers had been. However, with Ned in front of me I did see one thing that had not been evident through the one-way mirror. Ned was trying so hard to learn, his body tense with effort. But

something seemed to be interfering. Despite his efforts to concentrate, he just couldn't do it. Impulsively I reached across the table and put my hand over his.

And then I felt it!

Ned was losing the muscle tone of his hands several times a minute in synchronization with his loss of concentration. How could I have missed something so obvious? Yet it had not been apparent through the one-way mirror. Ned was having petit-mal seizures several times a minute. Repetitive electrical discharges of this type are strangely disruptive phenomena.

The next day's examination of Gordy revealed the same kind of petit-mal seizures - fast repetitive electrical discharges which, gauging from the loss of muscle tone and loss of concentration, probably were accompanied by loss of consciousness. Most important, these discharges, occurring several times a minute, meant that memory traces for anything more than isolated facts, were not being established. Hence Ned and Gordy could learn some of the segmental bits of information that appear on IQ tests, but they had trouble with coherent wholes.

Realizing what was wrong, it was now so obvious how different the two were from the other students. Tony, one of our psychologists, who had followed both of them for several years described the characteristic difference. "Ned and Gordy don't gossip like the rest of the patients. They don't know the political intrigue of the hospital which the other patients find so entertaining. They don't even know the details of their own lives." Of course these defects had not shown up on the IQ tests.

As long as nothing more was required of Ned and Gordy than learning bits of information which had been simplified to the toddler level, they could succeed. This is what B-S-B does for alphabet recognition and word building. However, the story part of the teaching system, which was so important to the other students, was meaningless to them. And because they could not remember and therefore follow a story, Ned and Gordy could not use the contextual cues to help them learn.

The development of the new paradigm

By being unusual, by showing what someone whose brain is unable to follow a story can and cannot do, Ned and Gordy demonstrated how all-encompassing the effects of story comprehension are not only to learning, but also for human interaction. The other severely retarded students contrasted sharply in that despite their retardation they were story engrossed. They showed us that story comprehension is so fundamental and overrepresented in the human brain that even a severely damaged brain can almost always call on this capacity. Hal was our most extraordinary demonstration of this fact.

Diagnosed as having central cortical blindness which manifested itself in graphic aphasia, Hal was brought into our study to determine if the reduced memory-load techniques of B-S-B could overcome his defect. Also by that time we were curious whether the contextual cues from the stories could compensate for the reduced information input resulting from his graphic aphasia. Hal showed himself a total reverse of Ned and Gordy. He learned to read the stories in almost no time, expertly anticipating what would happen next. And yet even after he became a fluent reader there were occasions when he failed to recognize identical letters side by side as being the same.

For Hal, B-S-B's developmental linguistics, layout in idea units, and probably code approximation made a cognitive breakthrough possible. By using contextual cues he was able to compensate for what his brain could not see, for his graphic aphasia.

For Hal, as for most of us, the whole was more important in the learning process than the memorization of the parts. And the whole that B-S-B had used was the story. As it turned out, it was a crucial choice.

But what exactly is a story, and how does it come into being? When does story comprehension begin in development, and what is it composed of? How did evolution build the story capacity and the need for story telling that is so characteristic of our species? And what is the relation of story cohesion to thinking, and therefore consciousness?

It was the asking of these questions and my search for their answers that made me realize that B-S-B must have tapped something basic in human cognitive development. The stories and letters written by our beginning readers furnished the clue. Line by careful line, these written communications were built with idea units à la B-S-B. At first the idea units were composed of just a noun and its action verb. But even after becoming advanced readers, the letters and stories had traces of the original B-S-B idea-unit layout. And when our retarded students talked with us, they didn't use the haphazard techniques of the past. Instead they carefully put together what they had to say by first searching for the right noun, then the verb, gradually adding the adjectives and adverbs. They were putting together idea units which they used to build the bigger story. Sometimes our severely retarded students wrote out what they wanted to tell us. Again they mimicked the

layout of the beginning books, and with idea units they constructed the bigger story line by line. One of our students with a Binet IQ in the 30's explained his reason for writing things out in this way with "It help you think".

Once I realized that the fundamental unit of cognitive organization that B-S-B had tapped was the idea unit, which is actually a miniature story, the next question was where on the evolutionary scale does the idea unit or miniature story begin? At what stage does it appear in child development?

The evolution of the idea unit is a fascinating story of its own. Some of the higher mammals, as experiments with seals, dolphins, monkeys, chimpanzees, and gorillas have shown, can recognize and sometimes even express nouns and action verbs. Seyfarth's (1980) vervet monkeys had a different series of sounds for panther, snake or eagle; and each of these nouns produced a different response - or action verb. Here we see the beginning of the idea unit, which is also the beginning of the miniature story. On a personal level, many of us have known dogs that recognize the names (nouns) of certain objects like ball, stick, slipper; and verbs like sit, fetch and bark. An occasional dog - I had one - responds to selected nouns and verbs, differentiating the idea units quite skillfully. Roger Fouts (personal communication) restrained one eager chimpanzee from going into the next room by signing to her that there was a dangerous monster on the other side of the door. The chimpanzee's reaction was reminiscent of that of our own children: she requested that he sign "the story" again and again, shrieking with delight at every repetition.

As for our human children, already by the time he/she can express two words (at about one year of age) there is an implicit understanding of some of the idea units that

appear in the beginning B-S-B books. A two to three-year old uses "telegraphic" speech which is composed mainly of a noun and its action verb (an idea unit) to tell his miniature stories. He/she also demonstrates an understanding of how idea units are used to build bigger stories when requesting "read me story". B-S-B mimics this developmental process, and by presenting in graphic form what the human mind does naturally, the teaching system not only facilitated the learning of reading, but actually taught (albeit unintentionally) how language and therefore thinking are put together.

The idea unit, or miniature story, as a unit of information processing is not the only way that information storage and processing could or has evolved. An example of an alternative way is that of the bees. Theirs is a highly efficient form requiring the investment of only a tiny nervous system. In contrast, the mammalian brain is an expensive energy investment. However, it has a building block that has evolved to allow for the organization and storage of an astonishing volume of information which can be recombined in numerous different ways. It also led to the uniquely human way of structuring reality which, as the B-S-B results have shown, can be developed beyond our wildest hopes.

Describing the idea unit and its implications for human learning, retention, thinking and awareness, it gradually dawned on me that I was describing that mythical construct, the engram. Except that it wasn't mythical, but something astonishingly concrete whose development could be traced through the evolution of the higher mammals; a development that is recapitulated in the ontogeny of every child. This idea unit, this engram, functions as our cognitive organizer and therefore structures our conscious reality. As our memory engram, and because of its nature,

it involves the whole brain (including our emotional limbic system), which explains why it was present in almost all of our severely retarded (damaged) subjects (Fuller, 1982).

The story engram has given us a powerful cognitive tool. With it we can organize, summarize, and reintegrate an enormous amount of information. But the story engram does more than help us remember facts, happenings and bits of knowledge. By imposing a structure on reality it determines how we humans perceive our world. The causal relationship, the either/or phenomena, the dichotomies, are imposed by an engram that derives its structure from a noun-action-verb ontogeny. It therefore determines and defines what is human logic. Here is the "neural interpreter" that Gazzaniga (1988) describes in his split-brain experiments, and the evolutionary "tricks to enlarge memory and speed computation" (p. 60) of Edward O. Wilson (1984). All the sophistication of artificial intelligence (AI) has not been able to simulate the power of our cognitive organizer, the story engram, in navigating the real world. But then, according to Feigenbaum (1983) "getting around in the real world is not a highly structured task...." (p. 57).

As the cognitive building block, the story engram is so fundamental to our thinking process that it is difficult for us to imagine an alternative way of perceiving our world. So completely do we take this way of structuring reality for granted, that that even the aliens of our science fiction invariably communicate in story form. This despite the fact that numerous life forms on our own planet have evolved alternative ways of communicating and information processing. My own slowness in recognizing what aspect of cognitive organization B-S-B had tapped is an example of both, how much we take the story engram for granted, and

how little we are cognizant of its existence. Yet this lack of awareness goes hand in hand with a deep emotional attachment to our cognitive organizer to whose manifestations and elaborations we devote much of our waking life.

There are several reasons for this attachment. As we saw with our B-S-B students, the story engram, by functioning as our cognitive organizer, has made us a story-telling-thinking species. And because the engram has a feedback loop into the limbic system, our stories can make us cry, or laugh, or produce any other emotion that belongs to us. Rico (1983), using her clustering technique which elicits the story engram, has demonstrated the clinical and cognitive power of this feedback loop.

But there is another very important aspect of the story engram that we saw in our students. After they had learned to use the story engram to build the bigger stories with which they described themselves and their world, they matured far beyond IQ expectations (Fuller et al., 1975). Having learned to impose a structure on the world around them, they saw themselves as having acquired a structure, an identity. What had once been suffering, voiceless masses of protoplasm, now became thinking humans beings. Descriptive of this is the moving account by Linda MacRae Campbell (1988, 1986) of the metamorphosis of her institutionalized retarded student into a would-be autobiographer. He succeeded in his dream, and in his heartfelt thank you letter to B-S-B. Bill Knacke's *Inside World* (1988)* is a vibrant demonstration that for us humans the telling of the human story creates awareness or consciousness. Descartes should have proclaimed fabulor ergo sum, instead of cogito ergo sum; because with story creation we define our very being. Story

organization allows us to look at ourselves, talk and think about ourselves, and maybe someday know ourselves.

The intellectual history of mankind, a meager six thousand or so years old, is deeply entwined with the development of the story engram as our cognitive organizer. With it we transmitted from generation to generation the successes and failures of the past as well as the explanations and hopes for the future. The advent of literacy formalized this transmission. But something more happened.

The linkage between literacy and the intellectual explosion of the last six thousand years is no accident. For literacy facilitated the isolation of the engram, allowing the writer to headline or highlight an idea unit as a concept or construct. As with our B-S-B students, this helped highly educated people to think. These literate intellectuals had learned (albeit implicitly) how to isolate engrams and determine how well they imposed a structure on the chaos of life. In this way they also found out that engrams which cannot be validated may give the wrong structure with which to think, and that accurate engrams can be tools for further understandings. It is the validation of engrams that brought about our age of science - an age which is just a few hundred years old. In these last few hundred years we have learned that accurate engrams can indeed be used as scaffoldings for marvelous edifices of the human mind. How very ironic that it was severely retarded students, not an intellectual elite, who recapitulated this historical process and showed that knowing how to build engrams, and using them for further building of stories and ideas, brings with it an emotional and intellectual metamorphosis.

But in addition, the B-S-B results established something quite unexpected. They demonstrated that engram building can be taught, with astonishing results for even the least endowed. Results with normal four-year-olds have been just as spectacular, creating demands for further research. The findings to date give us a glimpse of the potential achievements that could be within the reach of the human species as we seek metacognitive understandings with our neurological - behavioral building block, the story engram.

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